

January 29, 2001

**Indian Point 2 Response to Violation  
50-247/2000-10  
Con Ed Letter, Appendix B**

	Ref.	Licensee Statement	Comment
1	<b>Sec A</b> para1 pg19	SG tube in service examinations were conducted in accordance with industry guideline and requirements applicable at the time of examination	EPRI Guidelines
2	para1 pg 19	1997 inspections used conservative approaches in both selection of inspection sample, and in the analysis guidelines and reporting requirements	EPRI Guidelines
3	para1 pg 19	Data were analyzed by experienced and qualified personnel who received site specific training in accordance with Revision 4 of the EPRI PWR Steam Generator NDE Guidelines	EPRI Guidelines
4	para1 pg19	Probes, techniques and procedures were the most advanced qualified technology available at the time	10 CFR 50 App B
5	para2 pg19	Although not required, the licensee hired an independent eddy current expert to provide oversight of the principal contractor	10 CFR 50 App B
6	para3 pg19	Failure to detect instances of PWSCC in 1997 was associated with the inherent subjectively-based limitation of eddy current testing at that time, and was acknowledged by the NRC through Info. Notice 97-26, (5/19/97)	10 CFR 50 App B
7	para1 pg 20	Ease of detection of the indication was questionable, and it is supported by various NRC consultant opinions in TAC No. MA9163, dtd 10/23/2000, p 9)	10 CFR 50 App B
8	para2&3 pg20	Current inspection capability and standards should not be applied retroactively to 1997. This is supported by several affidavits of SG inspection and eddy current experts	10 CFR 50 App B
9	<b>State-ment1</b> para1 pg2	During 1997 inspection a single U-bend PWSCC indication was detected; the indication did not leak at the EOC-13, and the tube R2C67 was plugged consistent with industry practice	10 CFR 50 App B
10	para2&3 pg21	The EPRI PWR Steam Generator Guidelines, Revision 4, Volume 1, recommended SG tube inspection frequency and sample size. The requirement for U-Bend IGA/ODSCC/PWSCC is 100% of Row 1 & 2. The 100% inspection of Row 2 & 3 U-Bends with a qualified, rotating +Point coil met this requirement.	EPRI Guidelines
11	para4 pg21	The indication found in 1997 was based on the first +Point inspection of the IP 2 low row U-Bends; it was reasonable to conclude that the detection of U-Bend PWSCC in R2C67 was due to enhanced detection capabilities of the +Point probe than to accelerated tube deterioration during Cycle 13	10 CFR 50 App B

indications of  
"hourglassing"?

M/23

12	para2 pg22	The appearance of a single Row-2 U-Bend PWSCC indication was not an unusual event, and the characteristics of the indication were consistent with the data included in the SSPD training and testing materials. The plugging of tube R2C67 was an appropriate response	10 CFR 50 App B
13	para4&5 pg23	The +Point probe was qualified and added to the EPRI performance demonstration data base in May 1996. The NRC IN 97-26 described this test as qualified for detecting indications in small radius U-Bends <u>"in accordance with enhanced qualification criteria developed by EPRI"</u>	EPRI Guidelines
14	para1 pg24	PWSCC in the R2C67 tube was not an unexpected finding thus no modification to the inspection program was needed, and the program covered 100% examination using the most sophisticated qualified probe available	10 CFR 50 App B
15	<b>State- ment 2</b> para2 pg25	1997 low-row U-Bend probe restriction should be evaluated in light of historical experience. In 1997, 19 tubes had restriction that prevented a 0.610-inch +point probe from passing through the tube. This was specifically discussed in the RAI response to Question 11	10 CFR 50 App B
16	para4 pg25	The significant factor in 1997 examination was that the +point probe was of different physical geometry. All previous U-Bend examinations had been performed with very flexible ball joint bobbin coil probes of different mech.	10 CFR 50 App B
17	para3&6 pg26	Because of the different probe geometry, the licensee concluded that the most of the probe restrictions encountered in 1997 were due to conditions existing before 1989	10 CFR 50 App B
18	<b>State-m ent 3</b> para4 pg27 para2&3 pg29	In 1997, no formal criteria existed in the industry for quantitative evaluation of noise, and it should be noted that EDM notches typically yield larger signal amplitude for a given depth than PWSCC	10 CFR 50 App B

EA-00-179

Draft Letter to Baumstark

SUBJECT: RESPONSE TO NRC SPECIAL INSPECTION 50-247/2000010 - STEAM  
GENERATOR TUBE FAILURE

As the reviewing official, I am responding to your letter dated January 19, 2001, in which you contested the Notice of Violation concerning Con Edison's 1997 steam generator inspections. The violation was issued on November 20, 2000, by Mr. Hubert J. Miller, Regional Administrator, Region I. While you do not agree with the violation, I note that the NRC and you are in agreement that steps be taken to improve your steam generator inspection program.

I have determined, after careful consideration of the bases that you have provided, that no additional information was presented that would alter the NRC's conclusion that a violation existed. The information in your letter was not substantially different that provided to the NRC during the NRC special inspection and subsequent meetings. This was consistent with the regulatory conference conducted on September 26, 2000, during which you stated your disagreement with the violation, but provided no additional information.

Regulations in 10 CFR 50, Appendix B, requires, in part, that significant conditions adverse to quality be evaluated and actions taken to prevent recurrence. This regulation recognizes that prescriptive requirements cannot be written for every condition that may be encountered, particularly in the case of plant specific conditions. Therefore, when such conditions are encountered, licensees must take actions that are commensurate with its significance. Such conditions were encountered during the 1997 steam generator inspections. Based on industry information that was available, these conditions indicated an increase susceptibility of the low row tubes to primary water stress corrosion cracking (PWSCC) and an adverse impact on detection of tube flaws. Your evaluation of these conditions and corrective actions were not adequate and contributed to leaving tubes with PWSCC flaws in the low row tube in service.

In your letter, you made several statements that the NRC does not agree or believe to be pertinent. While I do not intend to address each and every statement, ...

[Based on the level of detail we need to provide]

... I address some of the your key statements in Attachment A of this letter.

or

... I would like to highlight two specific statements. In your letter, you stated, "it is not clear what 1997 SG inspection program adjustments would have been made to compensate for the effects of particular noise levels in diminishing the detectability of flaws even if those confounding influences had been appreciated." Further, you stated that the signal to noise ratio for R2C67 was three to one. It is important to note that the flaw in R2C67 was identified during the 1997 steam generator inspections. However, while the signal to noise in that immediate region was three to one, the noise in similar low row u-bend areas was much higher, and a signal to noise ratio of three to one was not achieved. As stated in the affidavit of Stephen Brown, the amplitude of the missed indication in R2C5 is comparable to the reported identification of R2C67 i.e., 2.31 volts

versus 2.16 volts. However, the peak-to-peak noise level in R2C5 was higher by roughly a factor [of] four.

While the NRC does not intend to prescribe what Con Edison should have done in response to the conditions encountered by Con Edison in 1997, the NRC believes that adequate evaluations and corrective actions in response to the significant conditions encountered during 1997 would reasonably have prevented leaving the flaws in the low row u-bends in service. The high signal noise in susceptible areas to PWSCC (i.e., the low row u-bends) could have been accounted for in the inspection program.

Adjustments could have been made in closer interrogate those susceptible areas or simply plugging the tube. Neither of these adjustments were considered in 1997, although it was reasonable for you to have done so.

Although you contested the violation, you also provided corrective actions, either planned or completed, in response to the violation. NRC Region I will review your corrective measures to resolve this violation in a future inspection.

AFFIDAVIT OF THOMAS C. ESSELMAN

"13. Since the IP2 visual examinations, up to and including those during the 1997 inspections, had not indicated any visual observable hourglassing of the top plates and knowing that all the Row 1 tubes in the IP2 SGs were plugged, I was of the opinion in 1997 that any minor -- non-observable -- hourglassing at the top support plate, if it existed, would not pose a significant threat of crack initiation or crack growth in the U-bend region of Row 2 tubes (Row 1 tubes at IP2 were plugged). This opinion was based on my experience and lack of industry data that indicated that small radius U-bends could be sensitive to a very small amount of hourglassing in the top TSP. Available data indicated that failures in Row 1 U-bends were the result of significant top support plate hourglassing such as noted in the Surry 2 flow slot closure. Furthermore, based on the Surry data (see the Virginia Electric and Power Company letter from C.M. Stallings to B. C. Rusche, USNRC, Serial No. 260C/092276, dated January 3, 1997 providing supplemental data for continued operation of Surry Unit No. 1), no cracks were detected in laboratory examination of Row 2 tubes taken from steam generators that had experienced Row 1 tube cracking." (pg. 5)

"... could not have been noted in 1997 through the secondary side visual inspection methods." (pg. 7)

AFFIDAVIT OF JON J. FUNANICH

"When the 100% axial EDM notch is set to 30 degrees in both the 400 kHz and 300 kHz channels, the 40% ID axial notch's phase angles are 11 and 13 degrees respectively. Therefore, the calibration was within the qualified technique's required range. Based on this evaluation, I have concluded that the IP2 calibration met the requirements of ETSS-96511." (pg.4)

AFFIDAVIT OF STEPHEN D. BROWN

"11. Thus, there was no industry rotating probe eddy current data from extensively

dented units with apex cracking that could be used for reference or application during the 1997 Indian Point 2 steam generator examination. ... rotating probe eddy-current data from non-dented units did exist. However, there was no factual basis that could be applied to this data to determine its adequacy (or inadequacy) since no extensively dented U-bend apex reference data set existed for comparison." (pg. 3)

"... while the U-bend data was qualitatively noisy, the data was able to be analyzed using 1997 industry practices and technology and was not atypical of noisy data encountered in other plants contemporary with or prior to the 1997 timeframe." (pg. 4)

"... This was the first and only industry data point from which a conclusion could be drawn about data quality. Based on this single observation, there was no evidence that tube noise levels might be impacting detection; 2) The noise levels in the U-bend data were within other industry analysis experience prior to and contemporary with the Indian Point 2 1997 timeframe. Thus, Indian Point 2 tube noise levels were not unique; 3) While the U-bend rotating probe data is noisy, this factor alone should not have prevented indications in R2C5 from being reported. The amplitude of the missed indication in R2C5 is comparable to the reported identification in R2C67 i.e., 2.31 volts versus 2.16 volts. However, the peak-to-peak noise level in R2C5 was higher by roughly a factor a four." (pg. 7, 8)

"48. In order to have implemented an eddy current data quality or noise level requirement during the 1997 Indian Point 2 outage one significant item was necessary; a flaw signal data base from which to infer acceptable noise levels.

49. This database would be constructed from a set of eddy current signals obtained from tubes with denting assisted U-bend apex PWSCC." (pg. 8)

#### AFFIDAVIT OF RICHARD S. MAURER

"Therefore the set-point in IP2-97-E used in the 1997 Indian Point 2 inspection satisfied the lower end EPRI guidance threshold for phase. (pg. 4)

"In addition, although not addressed in the EPRI ETSS, the Westinghouse procedure

appropriately includes the following passage which is intended to encourage analysts to report flaws "The phase relationships and confirmation by other coils should be viewed in the light of other influences which the probe experiences. The analysts should feel free to use his/her discretion in reporting signals which are felt to be indicative of a degraded condition, but do not necessarily meet all of the criteria indicated above. The over-riding rule of analysis should be: if you think there is an indication, report it."" (pg. 4)

"... requires that the analyst has an 80% probability of detection at a 90% confidence level for flaws which are  $\geq 40\%$  through-wall depth. An integral premise of this criteria therefore, is the acknowledgment that not all flaws will be detected by the analysts.

... This is due to the fact that there simply wasn't sufficient plus point data available in the industry at this time to construct a test which would satisfy the statistical confidence factors required under Appendix G." (pg. 5)

AFFIDAVIT OF KENNETH R. CRAIG

"... Based on my observations I conclude that the number of tubes repaired for denting, during the 1997 refueling outage, is an expected outcome of the examination and is reflective of a continuous slow denting rate as a result of either continued corrosion or reallocation of existing denting stresses in the drilled support plate." (pg. 4)

"17. A 1995 Dominion Engineering predictive report, DEI-442, identified the potential for PWSCC at future cycles for the IP-2 steam generators." (pg. 5)

"18. The initial 1997 examination scope recognized the industry experience with PWSCC in inner row U-bends. The scope included examination of all active Row 2 and Row 3 U-bends using the best available technology in 1997 ... per the EPRI Steam Generator Examination Guideline recommendations." (pg. 5)

"22. ... the occurrence of a single Row 2 does not represent a significant change in the condition of the IP-2 steam generators." (pg. 6)

"36. ... there was no evidence in the 1997 inspection data that the flow slots were experiencing significant hour-glassing." (pg. 8)

"44. Based on the foregoing discussion; the steam generator program in place prior to the 1997 IP-2 steam generator examination was a mature program with well documented examination histories, long range planning and identification of remedial actions." (pg. 11)

"46. In my opinion there was not enough aggregate evidence to suggest that PWSCC of Row 2 U-bends, as a result of denting and/or flow slot hour-glassing, would be a significant event at IP 2 during the cycle of operation following the 1997 examination." (pg. 11)